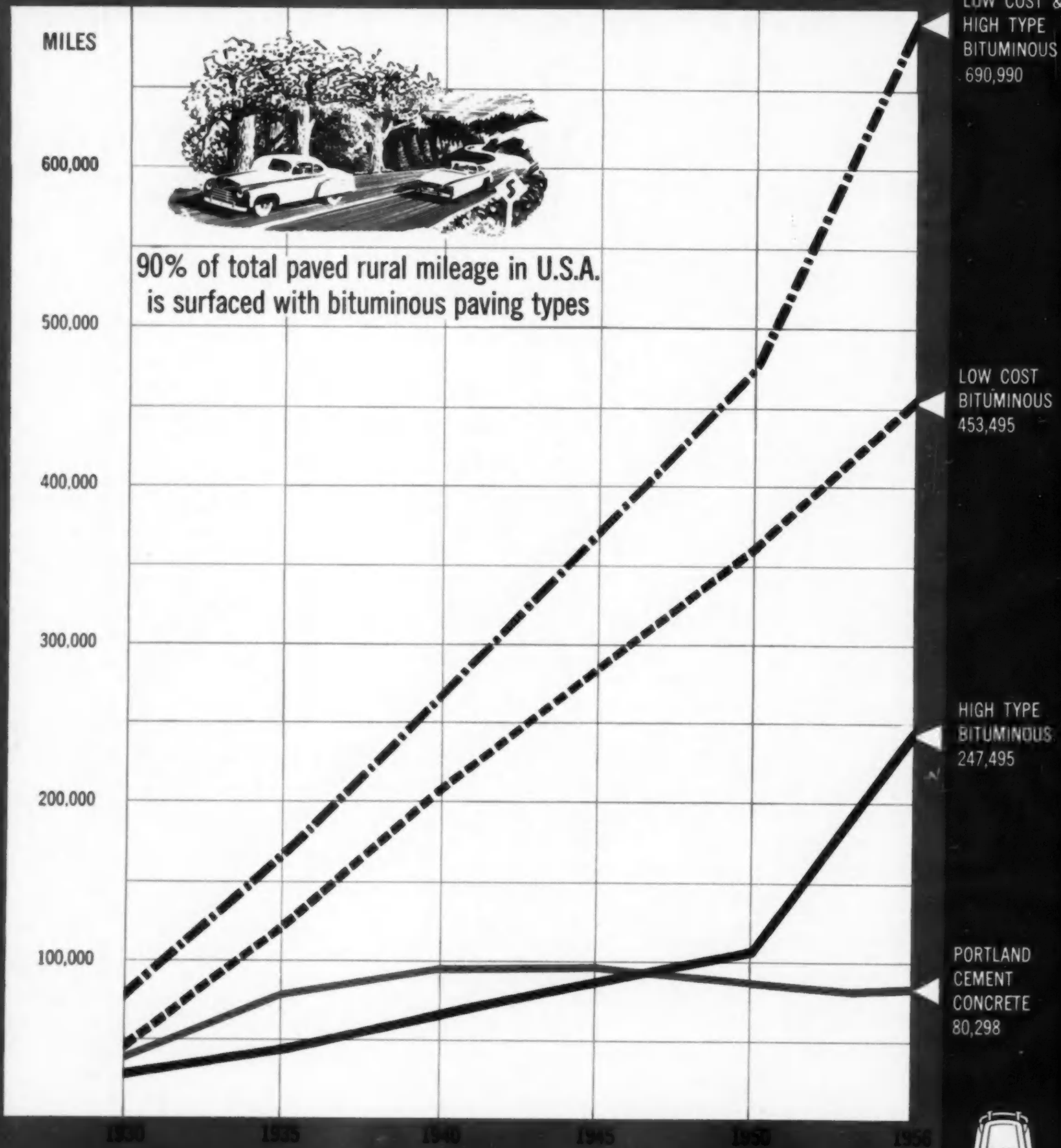
ASPHALT INSTITUTE *Quarterly*

APRIL, 1958

In this issue: EARLY STREET PAVING

EXISTING SURFACED MILEAGE ON RURAL ROADS

BITUMINOUS TYPES AND PORTLAND CEMENT CONCRETE



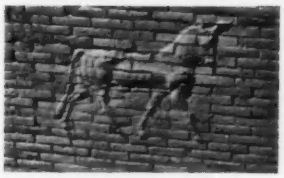
MUNICIPAL MILEAGE 1956

Sources: U. S. Bureau of Public Roads; also American Association of State Highway Officials for rural roads on state systems, 1930, 1935, 1940 and 1945

CHARTED BY THE ASPHALT INSTITUTE
APRIL 1958

ASPHALTOPICS

For years it's been the well-established custom in Britain for the contractor to furnish five years of free maintenance on all hot-mix asphalt surfacing jobs. But recently, England's municipalities have shown a marked tendency to demand only a 12-month maintenance guarantee. The reason? Modern asphalt pavements are now expected to give maintenance-free service well beyond the five-year period and this limitation has lost its meaning. Faults, if any, are expected to show up in the first year.



Speaking of long service, consider the asphalt used by the ancient Babylonians for cementing brickwork. Waldo Bowman, editor of ENGINEERING NEWS RECORD, snapped a photograph of a 2500-year-old Babylonian wall (see picture) during his tour of the Middle East last year. Not only is Editor Bowman's shot an interesting study in primitive asphalt technology, but it shows that the artisans of Nebuchadnezzer's day were crafty fellows when it came to bas-relief design.

Offhand, we can't think of a more unlikely place for the *Quarterly* to turn up than in the reading rack at the Anchorage, Alaska, Public Library. But Pfc. Fred Bruckner of Milwaukee, now on Alaskan duty, writes that he wandered in there one day and picked up a copy of our October 1957 issue. An auto-racing buff, he was attracted by the cover shot of action at the State Fair Park near Milwaukee where he spent his last home furlough, inhaling the heady mixture of ethyl gasoline and methyl alcohol. Browsing through the *Quarterly*, he says, was just like a visit home. Pfc. Bruckner thoughtfully adds: "I don't know anything about building highways or the material to be used, but without a doubt asphalt is the smoothest surface I have ever driven on."

Meanwhile, Mr. E. P. Pitman, Engineer of Materials for The Port of New York Authority, chides us for a misstatement in our January article on the resurfacing of the Lincoln Tunnel. Mr. Pitman points out that the penetration grade of asphalt used in the paving was between 55-60, not 85-100 as we reported. We don't know how this error crept into the story unless it's just the result of general inflationary tendencies.

RESIDUAL ITEMS: Traffic on the asphalt-paved New Jersey Turnpike during 1957 topped an average of 100,000 vehicles per day . . . from a government project engineer in Iraq comes this note: "We are here using in our roads the asphaltic concrete type. All our roads now and in the future will be asphaltic concrete" . . . asphaltic concrete helicopter landing pads have been designated for the Navy's three Texas towers in the Atlantic Ocean . . .

ASPHALT PAVES OUR FINEST HIGHWAYS

ASPHALT INSTITUTE Quarterly

Volume 10, No. 2 April, 1958

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Cover

Rare photo shows last paving of Pennsylvania Avenue, Washington, D.C., in 1907. The mix design consisted of asphaltic cement (100 parts refined Trinidad lake and 1[illegible] parts petroleum oil flux), sand and limestone dust filler. See Page 4 for same pavement today.

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Pennsylvania Avenue today. Essentially, this is the same asphalt pavement laid a half a century ago (see cover).

THE PAVEMENT OF E

A Survey of Early Washington, D.C. A

This 25-year-old pavement on E Street behind the White House is two inches of asphaltic concrete on seven inches of black base. Maintenance costs have been negligible.

As far back as 1832, Pennsylvania Avenue in front of the White House was macadamized. Today it is a 25-year-old asphalt pavement. Bench (foreground) is Bernard Baruch's wartime "office" in Lafayette Park.

By J. N. Robertson

Director of Highways, District of Columbia

By its very nature as the seat of government, Washington, D.C., is something of a national melting pot. The annual influx of political camp followers tends to engulf the native inhabitant until, as in New York or Miami, the discovery of a genuine native resident becomes something of an occasion. Jack Robertson is that rarity, a native of the District, born almost in the shadow of the Capitol on The Hill. His entire professional career has been spent with the District of Columbia Department of Highways, starting as a chainman in 1917. He worked his way up through the ranks until in 1948 he was appointed Director of Highways. Mr. Robertson has built a national reputation in the highway engineering field and served two terms as president of the American Road Builders' Association, in 1955 and 1956. He is a member of the American Society of Civil Engineers and a vice president of the American Association of State Highway Officials.

Paved in 1917, Fourteenth Street is scheduled for face-lifting this year. Tall building on right is National Press Building

PRESIDENTS

Asphalt Paving

THE NATION'S CAPITAL City is noted for its stately buildings and monuments, its beautiful parks, and its broad avenues and streets. We have nearly 1,250 miles of paved streets and highways in the District of Columbia over which flows a tremendous volume of city traffic as well as an influx of visitors every year from all points of the earth.

It is no accident, however, that Washington's highways are known for their attractiveness and serviceability. The effective improvement of our street system as it is today dates from 1870 when a great program was started "to make the City of Washington a Capital City worthy of a great Nation."

During the administration of President Grant, 180 miles of streets were graded, 128 miles of sidewalks were built, 3,000 gas lamps were installed, and 6,000 trees were planted, many of which still contribute to the beauty of our roadsides. Nearly all of the streets in the developed areas of the City were paved with tar, asphalt, block or macadam, and there were soon more paved streets here than in any other city in the country.

DE SMEDT PAVED THE WAY

A Belgian chemist, Professor E. J. De Smedt, has been credited with laying the first asphalt street pavement in this country. That was in 1870, when he placed a small experimental plot of asphalt—either European rock asphalt or Trinidad lake pitch—in front of the City Hall of Newark, New Jersey.

The story of the development of asphalt street paving in Washington, D.C., however, is the prelude to all American municipal street surfacing. At any rate, our early program of improvements gained such prominence that Professor De Smedt himself was attracted to employment in the District in 1876, one of the reasons being "the laying of asphalt-surfaced streets had become so important a department of public works in the City of Washington that in 1876 the Office of Inspector of Asphalts and Cements was created."

The first "bituminous" pavement in Washington was a coal tar surface laid in 1870 on Vermont Avenue, N.W., between H and Eye Streets. During the next four or five years about 50,000 square yards of coal tar pavement were laid in various sections of the city.

THE SPIRIT OF '76

At the same time, according to the records, our first asphalt paving projects were completed. And by 1876 our road engineers were relying to a greater extent on asphalt mixtures. At first, Trinidad lake asphalt was widely used, although there was a brief interest in various types of rock asphalt, particularly an asphalt impregnated sandstone. The use of refined petroleum asphalt was not to come for another quarter of a century.

In 1876, a 15-block stretch of famed Pennsylvania Avenue between the Capitol and the Treasury Building was surfaced with rock asphalt. There are some who believe that was the first full-scale asphalt paving project undertaken in the District of Columbia.

However, District records show the first such project was completed in 1874, when Eye Street, N. W., between 13th and 15th Streets, was paved with Trinidad lake asphalt mix on a European rock asphalt base.

In 1895, 21 years later, this two-block stretch of Eye Street was stripped and resurfaced with lake asphalt. The segment

between 14th and 15th Streets continued in service until 1920, when it was replaced with a six-inch hydraulic cement base and asphalt surface. The segment between 13th and 14th Streets received a heater-planer surface treatment in 1927 but otherwise served to 1940. In that year the pavement on both blocks was replaced with a sheet asphalt surface on an eight-inch rigid base.

The District's second asphalt paving project was achieved in 1875, when Grant Place, now known as G Place, was paved with a lake asphalt mix on six inches of hydraulic cement base. With the exception of the resurfacing in 1889 of about 100 feet of paving on Grant Place, the original asphalt pavement lasted 56 years before it was replaced in 1931 with a petroleum asphalt mat on seven inches of rigid base.

NATION'S PARADE-GROUND

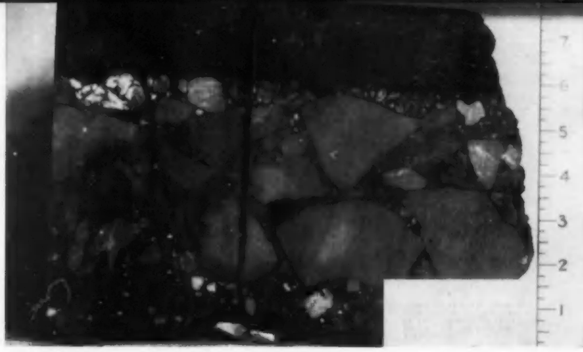
As for Pennsylvania Avenue, the story of the parades on this great thoroughfare would provide in itself an outline of the history of the United States. The inaugural parade is a national event which attracts thousands of visitors every four years. Thomas Jefferson, the first President to be inaugurated in Washington, walked to the Capitol in 1801 for the ceremony. President Wilson was the last President to ride in this parade in a horse-drawn carriage.

No parade in Washington's history, however, has ever equaled the Grand Review of the Union Armies on May 23 and 24, 1865. The parade route extended down Pennsylvania Avenue from the Capitol to the White House, in front of which the stands were occupied by President Johnson, his Cabinet, and the reviewing officers, headed by Generals Grant and Sherman. For two days the route was traversed by more than 200,000 troops of the Armies of the Potomac, Tennessee, and Georgia.

Pennsylvania Avenue was laid out in 1796 through low, marshy ground, and was once derisively called the great bog. It was macadamized in 1832 and further improvements were undertaken in 1876. From First to Sixth Streets, N. W., it was paved with Professor De Smedt's Neuchatel rock asphalt on a base of Potomac Valley hydraulic cement. From Sixth to 15th Streets, it was paved with Grahamite, a form of natural rock asphalt from West Virginia, on the same type base.

In 1890, the original rock asphalt surface was stripped and

This 45-year-old sheet asphalt pavement on C Street, N.W., was laid on a macadam base, is still giving sound service. Building on the left is Constitution Hall.



Washington's first "bituminous" pavement was this patented coal tar pavement, laid on Vermont Avenue between H and I Streets in 1870.

a surface of Trinidad lake asphalt was laid. In 1907, the Avenue was repaved with asphalt between Sixth and 15th Streets, and five years later the stretch between Third and Sixth Streets was resurfaced.

STILL IN SERVICE

The pavement laid in 1907 still serves Washington's most heavily travelled thoroughfare. Of course, it has been patched and heater treated in spots and opened for utility cuts time after time, but essentially it is a 50-year-old pavement.

From the early days, it has been standard practice in the District to lay sheet asphalt street pavements on rigid bases of concrete. This is still one of our standard designs except for the use of asphaltic concrete bases in the newer residential areas.

We also have examples of asphalt pavements laid on bases of macadam and coal tar.

An asphaltic concrete base was employed in 1933, when E Street, N. W., between 15th Street and West Executive Drive, a location directly behind the White House, was paved with two inches of asphaltic concrete wearing surface on seven inches of black base. This pavement is now a quarter of a century old and maintenance has been negligible with the exception of resurfacing in 1950 with an asphalt surface course when traffic islands were installed.

In 1913, C Street, N. W., between 17th and 18th Streets, was paved with sheet asphalt on a macadam base. This 45-year-old pavement has been patched periodically, but is still giving sound service. South Carolina Avenue, S. E., between 11th and 13th Streets was paved in 1913 with bituminous concrete on a stone base and is also giving adequate service at the present time.

THE HEAT IS ON

Another pavement familiar to every tourist passing through Washington is 14th Street, N. W., between Pennsylvania Avenue and F Street. With the Willard Hotel on one side and the National Press Building on the other, this is one of the most heavily travelled pavements in town. In 1917, a petroleum sheet asphalt pavement was laid here on six inches of rigid base. That 41-year-old pavement is scheduled for a full contract heater resurfacing this year.

Until the development of the heater-planer, it was the practice in the District to strip old pavements to the base when they had lost their life and flexibility. Although we still remove sections of old pavements today, much of our resurfacing is done by the heater method. The heater-planer burns off a fraction of an inch of an old asphalt surface and replaces

it with a thin wearing course of dense sheet asphalt. Such surfaces are expected to last at least 15 years.

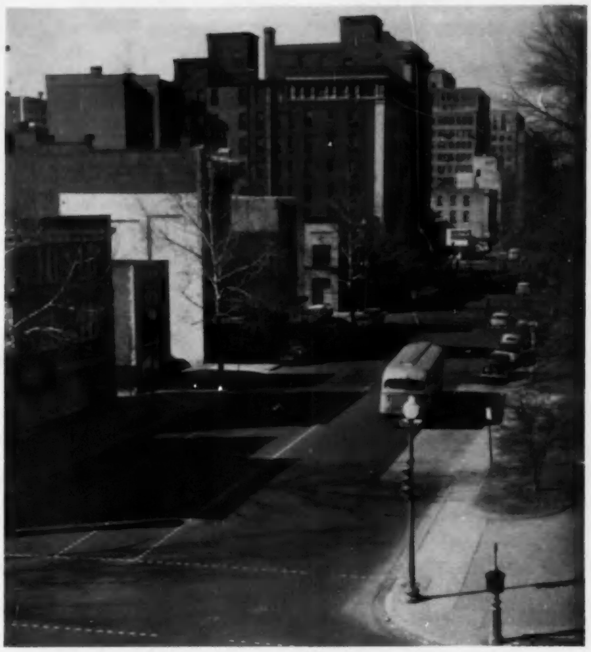
On new construction, our design for downtown streets calls for eight inches of reinforced concrete base with a total of approximately two and a half inches of compacted sheet asphalt binder and surface. Asphalt used is a 60-70 penetration. For residential streets one of our procedures is to use a design of hot asphaltic concrete base and wearing course, employing an 85-100 penetration grade asphalt.

AMERICA'S FRONT DOOR

No story of old pavements in Washington would be complete without including Upper Pennsylvania Avenue, especially the segment passing the White House between 15th and 17th Streets. In 1871, a Scharff-patent coal tar pavement was laid there in lieu of the 1832 macadamized surface. In 1879, it was replaced with an asphalt pavement on a hydraulic base.

In 1888, the asphalt paving was replaced by Amzi Barber, a contractor from Ohio, who earlier, in 1876, had undertaken the paving of Lower Pennsylvania Avenue. It was resurfaced in 1911 and again in 1930 with petroleum asphalt.

The growth of Washington, D.C., and the changes made in our highway system since 1870 would hardly have been possible without the continual improvement of road and street paving techniques.



First hot-mix asphalt pavement in Washington was put down in this block of Eye Street in 1874. It was replaced in 1940 after 66 years of service.

INSTITUTE GETS DOW, BARBER PAPERS

WHEN THE Asphalt Institute was privileged to accept the personal papers and books of the late Allan Wade Dow, a wealth of material was added to the Institute's growing repository of historical data on asphalt technology. The contribution was made by John A. Dow, son of the renowned paving expert and research chemist.

The significance of the Dow papers is clearly seen in light of the period of history they represent, a period that witnessed the somewhat painful transition from natural asphalts as a principal road-building material to petroleum asphalts. Prior to 1900 the main sources of asphalt were the natural deposits discovered in Trinidad and in Venezuela. Mr. Dow's early work was necessarily confined, therefore, to experimentation with natural asphalts.

CHAMPIONED PETROLEUM ASPHALT

Around the turn of the century, however, a new child was introduced to the road-building world in the United States, petroleum asphalt. It found a ready champion in the person of A. W. Dow, who quickly recognized the importance of this new material and battled to secure its proper recognition. Dow's remarkable foresight is reflected in the fact that of the approximately 19 million tons of asphalt marketed in the U. S. in 1957, less than five thousand tons were imported natural asphalt.

Dow devoted a lifetime to improving asphalt pavement construction both in the laboratory and in the field. His wide experience was gained from positions that included assistant chemist with the Barber Asphalt Paving Company in Philadelphia, Inspector of Asphalts and Cements for the District of Columbia, partner in the Dow and Smith consulting firm, and heading his own consulting engineering firm in New York City.

As one of the country's top paving experts and research chemists, A. W. Dow exerted a profound influence on an industry that was just beginning to feel its way a few short decades ago, an influence that is duly recorded in his personal papers and books.

(The Institute historical shelf also is the richer for the addition of four valuable volumes, gifts of the Barber Oil Corporation. These include the collected papers of F. V. Greene, 1880-1890; Halleck's "Bitumen" (1841); "Natural Rock Asphalts and Bitumens" by Danby; and a fine copy of Boorman's definitive work on asphalts. These rare books were presented to the Institute by Mr. W. L. Kallman, general sales manager of the Barber company.)

THEN

NOW

Porterville's Main Street was a 53-year-old pavement when resurfaced in 1955.

"Q.E.D."

—CALIFORNIA'S DURABLE STREET PAVEMENTS PROVED THE FLEXIBLE THEORY

AT LEAST SEVERAL YEARS before Professor De Smedt laid down his experimental pavement in Newark, N. J., some California coastal towns were reported paving their streets with native rock asphalt from Santa Barbara County.

Moreover, the great central valley and coastal areas of the state were rich in heavy asphaltic crude that seeped to the surface in several places, including the famed Brea pit near Los Angeles. The California Indians, like the Babylonians of old, used this natural asphalt for waterproofing their canoes and lining ditches. The early Spanish padres used it in roofing their mission buildings.

Years before the great California oil boom of the 1890's, enterprising Californians were refining oil for liquid asphalt and shipping it East where it was used as a flux with the imported lake asphalt, then in popular use for street paving. In California, however, these asphaltic crudes from the Kern River country were being used in paving mixtures with varying degrees of success. Refining processes were crude and there was a conspicuous lack of uniformity in the asphaltic cements. At one refinery it was reported that the process was regulated by hardness tests only, and to judge the progress of distillation the stillman dipped his finger into the material and made a "chew test."

THEN

D Street Madera, was topped after 42 years of trouble-free service.

NOW

Paved in 1905, Washington St., Los Angeles, was given a new asphalt blanket last year.

VISALIA REVISITED

THE MOST NEARLY indestructible street pavement in America must be the blanket of sheet asphalt on six inches of asphaltic concrete base that surfaces Main Street in Visalia, California.

In 1952, on the occasion of the San Joaquin Valley centennial celebration, The Asphalt Institute *Quarterly* reported that this 58-year-old street pavement had been carrying heavy cannery trucks and trailers, year in and year out, with no visible sign of distress. In fact, not a nickel was spent in maintenance on this incredibly durable pavement until an asphalt emulsion seal was applied in the early 1940's when shrinkage cracking became evident.

Today the pavement is as sound as the day it was built and shows no sign of deterioration other than some minor shrinkage cracking. Present City Engineer Harry A. Tow reports that no further maintenance has been required except for resurfacing of gutter areas where the turning action of automobile wheels created chuck holes, and another light emulsion seal for the entire surface of the street.

Visalia's 64-year-old asphalt street pavement continues to be one of the paving marvels of the age.

Nevertheless, it is a well documented fact that California, by painful process of trial and error, was advancing the technology of asphalt paving with petroleum asphalts long before the rest of the nation abandoned the imported lake asphalt. Consequently, it isn't surprising that the cities and towns in and around the San Joaquin and Sacramento valleys offer some outstanding examples of durable asphalt street paving.

The great central valley region became the scene of increased activity in asphalt street paving soon after the turn of the century, although public attention was first called to the use of crude petroleum oil in road improvement through experiments made by the county of Los Angeles in 1898. Results of these experiments were so successful that the practice rapidly increased. It spread through every county in Southern California and then began to work north. Extending from near the Mexican line northward to Durham in Butte County, a stretch covering sections of quite widely differing climatic conditions, there was a total of about 750 miles of oiled country roads and city streets.

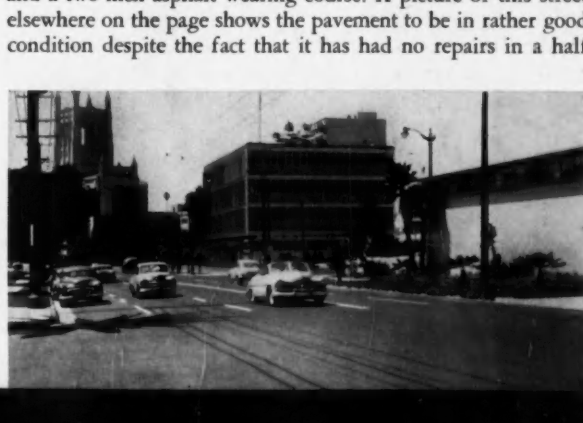
Hope Street, Los Angeles, was paved in 1908.

In constructing more permanent structures, however, California roadbuilders made a somewhat radical departure from the accepted technique. In an age when most recognized asphalt technologists insisted that only a rigid base would do, California built enduring asphalt street pavements with flexible asphaltic concrete bases. And while the rest of the country was satisfied that nothing compared with imported lake asphalt, California introduced the petroleum asphalt pavement.

Success of this new philosophy in road construction is evidenced by the many streets throughout the state with outstanding service records of half a century and more. The city of Los Angeles boasts several asphalt-paved streets in use today with histories dating back forty or fifty years. Possibly the oldest is Washington Street, which was laid in 1905. This street is composed of a five-inch asphaltic concrete base, one and one-half inch levelling course, and a two-inch asphaltic concrete surface. After 52 years of maintenance-free service, the pavement was resurfaced last winter with three inches of hot-mix placed in two courses, to cover old street car tracks.

Hope Street, another old timer in Los Angeles, is a busy four-lane thoroughfare, sturdily constructed in 1908 with a five-inch asphaltic concrete base, one and one-half inch leveller, and a two-inch asphalt wearing course. A picture of this street elsewhere on the page shows the pavement to be in rather good condition despite the fact that it has had no repairs in a half

Sixth Street, Los Angeles, paved in 1909, resurfaced last year.



a century of use. Engineers, however, consider it ready for a two and one-half inch surface course blanket.

Following closely on the heels of Hope Street from the standpoint of longevity is Sixth Street. Originally constructed in 1909 with a design similar to the other two streets mentioned, this six-lane thoroughfare received its first face-lifting just last year.

In Tulare County, practically in the foothills of the Sierra Nevada, Porterville offers another example of long-lasting asphalt paving. Situated in the orange belt of California, there is necessarily a great deal of heavy hauling to the railroad, nearly all of which must pass over the streets of Porterville. In 1910 this progressive community decided to improve its Main Street to accommodate the heavy produce traffic. As a result, a carpet of asphaltic concrete, consisting of a four-inch base and a three-inch surface course, was placed. After serving the community for 45 years, the street was resurfaced in 1955 with a two-inch layer of hot-mix asphalt.

THE VALLEY TOWNS

Since 1900, the city of Bakersfield has been improving her streets with asphalt. Strategically located on the Kern River at the southern end of the San Joaquin Valley, Bakersfield is an important railway junction. One of her more significant streets lies between 18th and 19th on Eye Street. This pavement was laid in 1913 with four and one-half inches of asphaltic concrete base and one and one-half inches of sheet asphalt surface. Except for a thin blanket of hot-mix asphalt, the street has required no other improvements and is smooth and in good condition.

Selma, on U. S. 99 just south of Fresno, is another city with a 40-year plus asphalt pavement. In 1920, the Selma Chamber of Commerce was so pleased with the excellent service of the asphalt-paved street laid in 1912 that it went on record as favoring asphaltic concrete for county highways as well as for the city streets. A blanket of hot-mix asphalt placed about three years ago has been the only improvement performed on the 1912 pavement.

At the geographic center of California and in the heart of the San Joaquin Valley lies Fresno. A healthy prosperous city, it is surrounded by irrigated lands of great fertility. Grains, hay, cotton, alfalfa, melons, and fruits are grown in vast quantities. But though the city is subject to severe climatic conditions, its streets for the most part are in excellent condition and present a pleasing appearance. Fresno laid its first asphaltic pavement in 1903. By 1920, the city had 3,254,996 square feet of asphalt paving. All the streets improved with asphalt are in good condition and have required little maintenance, even for the most heavily traveled streets.

From the standpoint of pavement-life studies, this glimpse at some of California's early experience with petroleum asphalt paving presents an impressive array of the material's capabilities. Although most of the pavements described here are more than 40 years old, the city of Los Angeles recently made a significant comparative report. The average age of the streets resurfaced in that city for the fiscal period 1956-1957 was 28.48 years for asphaltic concrete, 28.38 years for portland cement, and 21.24 years for rock and oil pavements.

It all adds up to the fact that there are more years of life in a street pavement built from the ground up of modern asphaltic concrete.

THEN

Eye Street, Bakersfield, has had one thin overlay since it was first paved in 1913.

NOW

THEN

Everything but the pavement has changed on Second Street in Selma since 1912.

NOW

THEN

Van Ness Street, Fresno, boasts a 47-year-old asphalt pavement which recently had a new asphalt blanket.

NOW

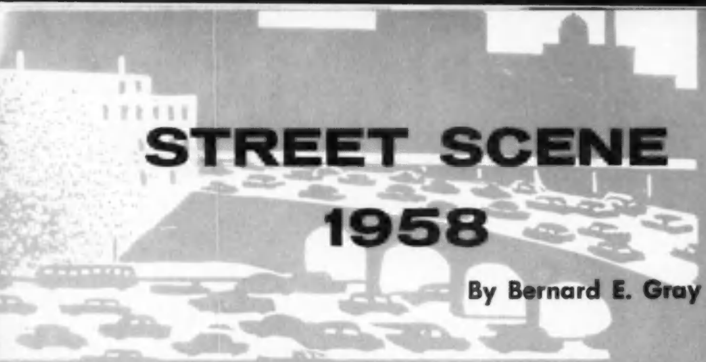
Busiest intersection in Portage, Wisconsin, is Cook Street at DeWitt Street. Bronze plate (right), shows date 55-year-old asphalt pavement was laid.

208 YEARS OF WEAR AND TEAR

U.S. 77 through Guthrie, Oklahoma was paved in 1909 with sheet asphalt, has never been resurfaced, maintenance virtually nil.

Broadway, Milwaukee, between Wisconsin Avenue and Michigan Street, paved in 1895 and still in use.

Mr. Henry C. Simmons (standing), retired street foreman in Lansing, Michigan, shows District Engineer Claude F. Skidmore the asphalt pavement he put down on Butler Boulevard in 1914. The original pavement is still in use and still sound.



STREET SCENE 1958

By Bernard E. Gray

Now retired after serving twenty-five years as Engineer, manager and president of The Asphalt Institute, Bernard E. Gray continues to maintain an active and inquisitive interest in road-building and asphalt technology. A native New Englander, Mr. Gray was graduated from Tufts College (now Tufts University) and entered upon a professional engineering career that has been distinguished by notable contributions to the literature of asphalt engineering. He compiled an enviable record with the Massachusetts and West Virginia state highway departments and the U. S. Bureau of Public Roads before turning his exceptional talents to administrative and promotional work with the Institute. Along the way, he never lost the zeal of the student and his restless mind, sternly disciplined in the broader classroom of practical engineering, earned him world-wide respect as a responsible spokesman for the developing science of asphalt technology.

CITIES NOW CONTAIN more than one-half of the population of the United States. The change from rural living, so dominant in our early history, has come about over the years through a steady trend to industrialization, expedited greatly by two world wars.

The change has led to more goods for more people, but it has brought many problems as well, in housing, water-supply, sanitary dispositions, and street paving. City streets, although but a small portion, mileage-wise, of the country's traveled ways (378,419 miles out of a total of 3,429,801) nevertheless now must serve over 80,000,000 people. It follows then, that street traffic is usually of high intensity while on the commercial arteries it is composed also of the heaviest loads.

THE SUPER-CITY

For a period there was a fringe, even around the largest centers, where traffic was relatively light, but as the suburb blends with the heart-city to form the tremendous modern metropolitan areas, the street system tends to become a series of long continuous routes, with all the problems attendant upon a heavy-duty rural highway plus the complications inherent in contiguous housing.

The change from rural to city traffic has been complicated enough, but the change in the character of traffic has been equally astonishing, from 100% horsedrawn to 100% motorized in but little over 50 years. In between, there was the era of trolley cars, which came with a rush and disappeared almost as fast. For years, however, there was a melange of horses, wagons, car-lines and automobiles, each to be taken into account, for each had its staunch and powerful advocates. A review of earlier technical papers on municipal public works reveals that the city engineer has had to meet the challenge of continual change and that he often must have longed for the simpler days of the nineteenth century.

THE STONE AGE

The first true city pavements were probably of cobble stones, natural water-worn stones that were set by hand in a sand base. Cut-stone block and brick followed shortly after and were smoother. Wooden block once was used quite extensively for it was not only smooth, when new, but was quiet also. Present day motor traffic is far from noiseless, but it is not so much the fault of the vehicle or the pavement as it is of the driver. Back in 1910, however, a single wagon on iron tires, drawn over a stone block pavement by a span of Percheron horses could produce a racket of no mean dimension, driver or no driver. Every hoof-beat fell with a force of nearly one thousand pounds, and when multiplied in numbers, plus some colorful language from the teamster, there was bedlam indeed.

Water-bound macadam was common on many residential streets and served well until growing motor traffic made the dust nuisance harder to bear than the noise of block-type surfaces. During this changing period asphalt pavements were being built on some of the principal business and residential streets, being considered a real luxury installation, not only durable, but smooth and quiet as well.

Their present almost universal use, however, came about from a remarkable combination of circumstances. One was invention of the balloon tire which diminished unit loads under the heaviest trucks so that thinner surfaces were adequate. The other was development of mechanical mixing and placement equipment of such efficiency that cost of the finished surfaces was greatly reduced. In recent years there has been a further advance in machine design whereby the upper part of an asphalt pavement can be restored to its original condition without need to replace the lower layer.

ASPHALT MEETS THE TEST

City streets today carry traffic similar in unit loading to that on the main rural highways, but there is some difference in both design and maintenance procedure, brought about by the numerous traffic lights, service cuts and the need for practically uninterrupted use. Stop-lights lead to more frequent use of brakes at intersections, hence, in general more dense and higher stability mixtures are required than on rural roads. Service cuts for water, gas, electricity, telephone and other utilities are myriad in number and must be patched immediately after closing. The pavement must be kept in condition for continuous use, as even a one-day, one-street, detour produces intolerable confusion and delay.

Asphalt is the unique material which best meets all these requirements. The harder mix resists the surge of heavy traffic in its frequent stops and starts, yet retains essential smoothness and resilience. The patch soon blends with adjacent areas so that both appearance and serviceability are maintained, while surface heater operations make possible full restoration of worn places in just the right amount with minimum delay.

It is perhaps not too much to say, that without the modern asphalt pavement present day city living would be difficult indeed, for only with asphalt has it been possible to restore smooth, quiet riding over abandoned car tracks and rough block pavements in addition to all the standard new construction that serves so well.

"I HAVE REACHED SOME CONCLUSIONS..."

by Robert W. Sweet

District Engineer
Department of Public Works
Watertown, New York

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THE FEDERAL HIGHWAY ACT of 1956 put this Country's highway industry right squarely "on the spot." For many years we have been saying, "Give us the funds and we will show you how to do the job." Well, here is the money and what kind of a start have we made? There are rumblings of complaint that nothing much is happening. There are warnings that the original estimates are too low. Many attempts are being made to expand the alloted mileage. Many cities would like to grab off some of that 90-10 money to build badly needed arterial expressways. Many cities, realizing the economic value of being on or near one of these expressways, have their politicians working hard to get the planned route placed to their advantage.

The estimates of cost of the Interstate System are already being revised upward. We are ready with the usual excuses of "creeping inflation," rising material costs and rising labor costs. I wonder if all that is the real reason these estimates always climb. I wonder if some agencies, dazzled at the prospect of spending that 90 percent Federal money have really tried to keep the cost down without lowering the quality. In reading the various articles and periodicals, one detects a departure from the usual engineer's posture of building for a dollar what any damn fool can build for a dollar and a half. With the heating up of the cold war and the howls of the school lobbies, perhaps we had better be a little more frugal. . .

ROAD COSTS CLIMBING

It is no news to highway administrators that the cost of road building has been going up and up in a steady climb, as inflation and higher standards of design have been imposed on the industry. When Detroit decides to build a lower car, thus dropping the driver's eye closer to the road, our sight distance standards immediately force us to flatter and more costly profiles. This is just one instance of circumstances beyond our control, forcing higher costs upon us.

Perhaps we have been a little too willing to say that these greatly increased costs are inevitable. Perhaps we have not searched hard enough for low-cost materials and methods. Perhaps we have not considered alternatives carefully enough. Perhaps we have not designed to take advantage of the economy and efficiency of modern road building machinery. Perhaps in thinking through the maze of a scientific jargon and learned outpourings of specialists, we have sometimes lost sight of the fundamentals of road building.

No doubt you have, as I have, waded through countless papers and articles on pavement design. We have had endless discussions on one type of pavement versus another. Many engineers have been deluded into thinking that pavement can be made to perform functions that should be carried out by other parts of the road structure. Some of our trouble has been that we have listened to a clever sales pitch masquerading as engineering reasoning. A road is a whole structure of which the pavement is merely one member.

Now let us consider which functions can logically be assigned to a pavement. First, it should shield the rest of the structure from water—hold an umbrella, in effect, over the sub-grade. Second, it should provide a smooth riding surface with good traction. Thirdly, it should resist lateral or longitudinal displacement or distortion. Fourthly, it should

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transfer the loads imposed upon it to the supporting layers. A pavement cannot economically perform the functions of a bridge slab, nor should it be called upon to do so.

THE "BLACKTOP" BOGEY

The tendency to over-emphasize pavement functions and the consequent increase in pavement cost has concerned me for many years. Over a career that now covers thirty-five years, I have observed the service of roads built to various sections and of various materials. With the full realization that this is not accepted scientific procedure nor logical reasoning, I have reached some conclusions. One of these conclusions is that highway engineers have neglected to explore fully the possibilities of flexible pavement design for heavy duty roads. Many top administrators, busy men that they are, have tended to lump all blacktop roads together in a common pile, and ignore the technical advances in the design, mixing and placing of bituminous concrete.

In recent years, two opportunities for experimentation have occurred in our area. About six years ago, New York State put into operation a weight-distance tax. They had to build a large number of truck weighing stations in order to do so. Each of the ten Department of Public Works Districts were asked to submit a design cross section for the approach pavements to the scales. This assignment fell under my supervision in the district where I was then employed. We proposed a flexible base section, consisting of a 12″ layer of gravel, 4″ of crushed stone base course, 3″ of penetration macadam, and 2½″ of plant mix bituminous concrete.

This section was so much cheaper than any other submitted that it was adopted state-wide. After six years of constant use under heavy trucks, none of these pavements have failed, and the actual pavement maintenance has been negligible.

The great St. Lawrence Seaway and Power Project is being built in my District. In 1954 the New York Power Authority asked for recommendations of a typical cross section for their supply road to Bernhardt Island. This road would have to stand all the hauling to the Long Sault Dam, the Power Dam, The Eisenhower Lock, and the Grasse River Lock, to say nothing of the hundreds of thousands of sight-seers. Bearing in mind the underlying soil of glacial till and marine clay, as well as the 4 to 5-foot frost penetration in that region, we recommended a two foot thick granular base. On it our cross section was basically the same as used at the weighing stations.

For over two years this road has been under constant day and night, week in and week out, heavy loading. It has averaged a twenty-ton load every two minutes since it was opened. Because of its special purpose one side has carried loaded trucks, while the other side bore the unloaded return trip. Under treatment like that, there has been no pavement failure. There is no discernible difference between the two sides. The Chief Engineer of the Power Authority informs me that maintenance of the pavement has been negligible. I consider that sufficient proof of the stability and durability of design.

Based on those results, we decided that such a pavement has enough stability for use on the Interstate System. The regular construction program was already overtaxing our portland cement suppliers. We had no desire to intensify that problem. Therefore, we adopted a bituminous flexible base cross section for that entire portion of the Interstate Highway System in our District. . .

THE SHAPE OF THINGS TO COME

THE STATE OF VIRGINIA, "Mother of Presidents," can rightfully be called "Father of Turnpikes" as well. Here, in 1785, the toll-road idea had its beginning in the United States when the state legislature authorized the construction of the Little River Turnpike, from Alexandria to the Shenandoah Valley. Here also, in 1958, what may well be the last of the American turnpikes will be completed between Richmond and Petersburg.

The July issue of the *Quarterly* ties these two historic road-building projects together in a neat double-barrel package saluting the asphalt-paved Richmond-Petersburg Turnpike.

Oddly, when Assistant Editor Bob Lowe began digging for information about the Little River Turnpike, even the august Library of Congress came up empty. The story of this road seemed lost in antiquity. Then, within 24 hours, it was splashed across the front page of the newspapers when a proposal was wafted in the Virginia legislature to resurrect the road and re-name it in honor of Colonel Mosby, the "Gray Ghost" of the Confederacy. This idea was promptly quashed by aroused old-line Virginians who discovered that John Mosby had jumped the fence after Appomattox and accepted a Federal job appointment under President Grant.

The stories of America's oldest and newest turnpikes will be told in "Virginia—The Beginning And The End" in the July *Quarterly*.

Also, former Asphalt Institute field engineer (now executive manager of the Western Asphalt Roofing Manufacturers Association) C. J. Van Til reports on "What's New In Asphalt Roofing," a subject we have allowed to gather dust for too long.

The specialized uses of asphalt will receive rather specialized attention. The manufacture and application of asphalt block will be reviewed also in "Patterns in Paving"—a comprehensive article on how modern block pavements offer beauty and durability for industrial floors or promenade roof decks.

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